Customer No.: 31561
Docket No.: 11843-US-PA
Application No.: 10/707,687

In The Drawings:

Please substitute the attached amended drawings of Fig. 3, Fig. 4C, Fig. 4F, Fig. 4I, Fig.5-6 and Fig. 8 for the pending drawings of Fig. 3, Fig. 4C, Fig. 4F, Fig. 4I, Fig.5-6 and Fig. 8. "FIG. 3 (PRIOR ART)", "FIG. 4C", "FIG. 4F", "FIG. 4I" and "FIG 8" are added in the drawings. In addition, in FIG. 5 "290" is amended to "190". In FIG. 6 "290" is amended to "190" and "295" is amended to "195".

REMARKS

Present Status of the Application

Appreciate corrections for the drawings and the specification are required. The Office Action rejected claim 1, 2, 5, 6 and 8 under 35 U.S.C. 102(b), as being anticipated by, or 35 U.S.C. 103(a) as obvious over Chia (U.S. 6,225,965). The Office Action rejected claim 3 under 35 U.S.C. 103(a) as obvious over Chia in view of Dahl (U.S. 6,051,888). The Office Action rejected claim 4 under 35 U.S.C. 103(a) as obvious over Chia in view of Ho (U.S. 2002/0163075). The Office Action rejected claim 7 under 35 U.S.C. 103(a) as obvious over Chia in view of Kumamoto (U.S. 2002/0109241).

Applicants have amended the drawings and the title to overcome the objections.

Applicants have amended claim 1 and cancelled claim 2 to more clearly define the present invention. After entry of the foregoing amendments, claims 1, 3-8 remain pending in the present application, and reconsideration of those claims is respectfully requested.

Discussion of Office Action Objections

In the drawings, "FIG. 3 (PRIOR ART)", "FIG. 4C", "FIG. 4F", "FIG. 4I" and "FIG 8" are added into.

In addition, "290" is amended to "190" in FIG. 5. "290" is amended to "190" and "295" is amended to "195" in FIG. 6, and the corresponding description at paragraphs [0049]-[0050] in the specification is also amended.

The title is amended to "CHIP PACKAGE STRUCTURE WITH HIGH RELIABILITY AND HEAT-DISSIPATING CAPACITY" that is clearly indicative of the invention to which the claims are directed.

Discussion of Office Action Rejections

The Office Action rejected claims 1, 5, 6 and 8 under 35 U.S.C. 103(a), as being unpatentable over Chia (U.S. 6,225,965). Applicants respectfully traverse the rejections for at least the reasons set forth below.

The present invention is in general related to a chip package structure as claim 1 recites:

> 1. A chip package structure, comprising:
> a carrier;
> a chip, having an active surface with a plurality of bumps thereon, wherein the chip is flipped over and bonded to the carrier in a flip-chip bonding process so that the chip and the carrier are electrically connected;
> a heat sink, set over the chip, wherein the heat sink has a surface area greater than the chip; and
> an encapsulating material layer, filling a bonding gap between the chip and the carrier and covering the carrier, wherein the encapsulating material layer is formed in a simultaneous molding process and part of the surface of the heat sink away from the chip is exposed, ***and the encapsulating material layer between the chip and the carrier has a thickness such that maximum diameter of particles constituting the encapsulating material is less than 0.5 times the said thickness.***

The Office Action points out that the limitation of "the encapsulating material layer between the chip and the carrier has a thickness such that maximum diameter of particles constituting the encapsulating material is less than 0.5 times the said thickness" is obvious to one

skilled in the art the time. In such a situation, Applicants must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range.

Applicants explain the claimed invention and the unexpected results as follows.

For the flip-chip package structure, it takes considerable time to fill up the bonding gap between the chip and the carrier with liquid encapsulating material through capillary effect alone. Because the capillary effect is utilized to draw liquid encapsulating material into the space between the chip and the carrier, any variation of the liquid flow conditions is likely to hinder the filling process leading to the possibility of formation of voids. If voids are formed between the chip and the carrier, the reliability of the package will be deteriorated.

In the specification of the present application (paragraphs [0061]-[0075], Figs. 9-10), Examples 1-8 and Contrast Examples 1-6 are described, wherein the flip-chip bonding gap (the gap between the chip and the carrier) in all of Examples 1-8 and Contrast Examples 1-6 is between 50 and 75 um. The magnitude of the flip-chip bonding gap is also the thickness of the encapsulating material layer between the chip and the carrier because the encapsulating material layer will be filled up the gap thereafter.

The maximum particle diameter in the encapsulating material for Examples 1-8 and Contrast Examples 1, 2, 5 and 6 is 21 um. The maximum particle diameter in the encapsulating material for Contrast Example 3 is 40 um while the maximum particle diameter in the encapsulating material for Contrast Example 4 is 74 um. The degree of vacuum of the molding

process in Example 2 is not less than atmospheric pressure and thus Example 2 is not listed in the following table.

	Flip-chip bonding gap	Maximum particle diameter in Encapsulating material	Ratio (maximum particle diameter/ flip-chip bonding gap)	Flip-chip bonding gap filling capacity
Examples 1, 3-8 & Contrast Examples 1, 2, 5 and 6	50 ~ 75 um	21 um	0.28~0.42 (>0.5)	97%~100%
Contrast Example 3	50 ~ 75 um	40 um	0.53~0.8 (<0.5)	40%
Contrast Example 4	50 ~ 75 um	74 um	0.99~1.48 (<0.5)	30%

As shown in the table, the maximum diameter of particles constituting the encapsulating material is less than 0.5 times the thickness of the encapsulating material layer between the chip and the carrier in Examples 1, 3-8 and Contrast Examples 1, 2, 5 and 6. The flip-chip bonding gap filling capacity of Examples 1, 3-8 and Contrast Examples 1, 2, 5 and 6 is so excellent. However, in Contrast Examples 3-4 the maximum diameter of particles constituting the encapsulating material is larger than 0.5 times the thickness of the encapsulating material layer between the chip and the carrier. The flip-chip bonding gap filling capacity of Contrast Examples 3-4 is obviously poor. If the flip-chip bonding gap filling capacity is higher, the voids formed between the chip and the carrier are less and the reliability of the package is better. Apparently, the flip-chip bonding gap filling capacity of Examples 1, 3-8 and Contrast Examples

1, 2, 5 and 6 is much higher than that of Contrast Examples 3-4. As a result, the reliability of the package for Examples 1, 3-8 and Contrast Examples 1, 2, 5 and 6 is better than Contrast Examples 3-4.

Therefore, the limitation of "the encapsulating material layer between the chip and the carrier has a thickness such that maximum diameter of particles constituting the encapsulating material is less than 0.5 times the said thickness" in claim 1 is critical and the claimed invention can achieves unexpected results relative to the prior art. Chia also fails to teach or suggest the limitation as above mentioned. Hence, Applicants respectfully submit that independent claims 1 patently defines over the prior art reference, and should be allowed.

For at least the same reasons, dependent claims 5, 6 and 8 patently define over the prior art as a matter of law, for at least the reason that these dependent claims contain all features of their respective independent claim.

The Office Action rejected claim 3 under 35 U.S.C. 103(a) as obvious over Chia in view of Dahl (U.S. 6,051,888), claim 4 under 35 U.S.C. 103(a) as obvious over Chia in view of Ho (U.S. 2002/0163075) and claim 7 under 35 U.S.C. 103(a) as obvious over Chia in view of Kumamoto (U.S. 2002/0109241). Applicants respectfully traverse the rejections for at least the reasons set forth below.

Applicants submit that, as disclosed above, Chia fails to teach or suggest each and every element of claim 1 from which claims 3-4 and 7 depend. Dahl, Ho and Kumamoto also fail to

teach or suggest the feature of "the encapsulating material layer between the chip and the carrier has a thickness such that maximum diameter of particles constituting the encapsulating material is less than 0.5 times the said thickness". Dahl, Ho and Kumamoto cannot cure the deficiencies of Chia. Therefore, independent claim 1 is patentable over Chia, Dahl, Ho and Kumamoto. For at the least the same reasons, their dependent claims 3-4 and 7 are also be patentable.

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CONCLUSION

For at least the foregoing reasons, it is believed that the pending claims are in proper condition for allowance. If the Examiner believes that a telephone conference would expedite the examination of the above-identified patent application, the Examiner is invited to call the undersigned.

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Respectfully submitted,

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